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SCIENCE

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FIRST GET THE FACTS¹

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THERE is connected with the Department of Commerce a remarkable institution called the Bureau of Standards. Its work is more or less familiar to you because one or more groups of students from this school have visited it at various times. I have on some occasions spoken of this bureau as the "house of accuracy," for in it in a special sense the truth is sought. We call the seeking of this kind of truth research. It may be chemical research or physical research or the act of research applied to any of the sciences that underlie our industries and public utilities. Truth is sought in this work because it is believed that the facts concerning nature are of infinite value to mankind. It is recognized that the effectiveness of our civilization rests upon facts first ascertained and then used. It is there thought faulty to proceed on the basis of incomplete truth or of undigested facts, and neither time, labor, nor expense is spared to find the facts and make them known to those who can use them.

One of the standards of the Bureau of Standards itself must be that of speaking the truth so far as it shall have become known, and men know they may depend upon what it says as expressing the truth within those limits in which it has been ascertained. To tell half of a truth if the other half were known would be thought a destructive violation of the very *raison d'être* of the service. To know the truth and not to tell it would be equally violative.

In what has been thus far said I have

¹ MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

¹ Address of The Honorable William C. Redfield, Secretary of Commerce, before the Case School of Applied Science, Cleveland, Ohio, May 27, 1915.

described only the normal workings of the scientific mind as applied to research. The mind of science is one of high ideals. It is a modest mind, for it recognizes that there are many things it does not know. It is a discriminating mind, for it tests and selects or rejects as the test may tell. It is a practical mind, for it aims to find the hidden things of nature and put them to use. It is an honest mind, for it seeks neither to deceive nor to be deceived. It is an open mind, ready to reject the truth which seems to be in favor of that which is proven to be. The scientific mind, if it be true to itself, knows no passion nor prejudice nor predilection, unless it be the passion for the truth that is not yet known, a judgment given in advance in favor of that truth when it shall be known and a preference for any form of truth whatever, and a distaste for shams. I have a friend who said that if he did not know why he knew what he thought he knew he wanted to know, and in this attitude of thought he expressed something of the outreach of the mind of science, which ever seeks to learn the what and the why of things.

In the business world facts are respected. This is so because facts are stubborn things and insist upon being respected. They have a way of bowling one over if one does not respect them. Enter a great mill and look about you. The machine which is nearest at hand is itself the illustration we seek. It is the embodiment of ascertained fact. As you stand and look at it and think of how it came to be you will find your mind running back through a long series of facts which one by one were gathered often through many years and which have ended in the mechanism which you see. If it were not made in accord with the facts out of which it grew it would cease to work and become a helpless thing. If it is not used in accordance with the facts which control

its service it ceases to be useful and again becomes a helpless thing. It is made up out of past facts. It is working out present facts, and its product often points toward the development of facts which are to be.

We stand, you and I, whether in school or office or mill, in the midst of a constant evolution of facts and development of truth. The truth of yesterday is not that of to-day. The truth of to-day is but the parent of that which is to be to-morrow. Prejudice and truth are enemies, and truth has no finer task than that which it daily performs of destroying prejudice. Where prejudice is, truth is so far excluded, for no judgment given in advance of known truth is either sound or safe.

Let us not, however, go on as if we were paying mere verbal homage to a high ideal. Let us become practical in the matter. The relation men hold to truth, their respect for facts, their use of facts, largely determines their place and power in life. We make progress in the business world not necessarily by research for facts but at least by outreach for them and by respectful treatment of them when they are found. If the mill you are some day each of you to run is not run in accord with the facts that environ that mill it will not run long. Nay, you may find the more obvious facts that should control the mill and by conforming to them may succeed a little. The amount of success will depend a good deal upon how far your vision goes in seeing the facts that surround you and on the extent to which your practise goes in using those facts. The man of broad mind sees more facts than he who has a narrower vision. Mental near-sight is usually not profitable. To be far-sighted is at times physically inconvenient but commercially has much in its favor. It is more essential, however, that the sight, whether it be far or near, shall know a fact when it sees it and be ready to abandon a

pseudo fact for a real one and to abide by the latter till further facts are found.

These suggestions are simple and primary, yet acceptance of them is all too rare. About all of us is a penumbra shutting out many truths we would do well to know. Amid the enlightened circle, which is perhaps not of the same size for any two of us, we walk with such light as we have. This perhaps leads us normally to repeat that profound truth from Holy Writ, "If the light that is within you (or, I may add, about you) be darkness, how great is that darkness!"

Facts have a cruel way of substituting themselves for fancies. There is nothing more remorseless, just as there is nothing more helpful, than truth. If your head comes in contact with the moving crank-shaft of an engine, the fact as to the relative hardness of the two will be both painfully and speedily determined. Yet it would not do to argue that because the crank-shaft breaks your head it was a destroying force in the world. Sometimes the head itself is more of a destroying force than the unconscious mechanism which it has created.

It is well, therefore, to be on the right side of the facts. This means that there are certain standards by which our opinions may be judged whether they are false or true. For the truth is not affected by what men think about it. Your or my unbelief in it does not make it less the truth. It is a stern though kindly standard that thus is daily set against our judgments, and if you and I fail to meet the standard it does not hurt the standard but it does hurt us. Those are fine lines which run:

It fortifies my soul to know
That though I perish truth is so;
That howsoe'er I stray or range,
Whate'er I do truth does not change.
I steadier step when I recall
That though I slip truth does not fall.

Shall men be able to rely on you in your working life? If so, it will be because they find by experience that in word and deed you meet the test of truth. Of one man we say he is fanciful; of another that he is a dreamer; of another that he is a pessimist; and of a fourth, an optimist, and by all these things we mean certain shades of criticism whereby we detect the departure from a certain mental standard of our own as to the relation a man should normally have to facts.

Prejudice then, and half truths, and narrowness of view, and obstinacy of thought, these are all weights men carry in the race of life; expensive things, bringing at times both pain and poverty into his lot who tolerates them.

I have intimated in substance that modern industry is the utilizing of certain facts or the outgrowths of them for the production of other facts; or to state it differently, that industry represents the practical application of truth to life. If one passes from the field of industry into public life there is nothing which strikes one more forcibly than the degree of absence of this relation to fact. Our scientific thought, our industrial thought, our agricultural thought, even our artistic and literary thought either pays homage to the laws of truth which govern those activities or at least panders more or less unwillingly to the recognized power of the controlling truths. This condition does not prevail to an equal degree in the discussions of public life. Nothing strikes one, leaving a business atmosphere for that of public service, more than the inaccuracy in statement and in criticism which is there found. Around the table gather the board of directors of an industrial company. As the facts concerning the company's affairs are discussed it is usual for those present to speak of the business in which they are concerned with

accuracy and for the listeners to believe that they speak the truth as they know it. I mean no personal and certainly no sharp criticism when I say that this is far from being the case when men, perhaps even the same men, meet to discuss public affairs. The things which are at times currently believed by many among us on various public subjects are not infrequently things that are not so, and criticisms are based and policies commended or condemned with astonishing frequency on the basis of things which are said to be but which do not exist. It is not throwing the standards of business discussion into excessively high relief to say that our public affairs would be vastly improved if the accuracy of statement and the courtesy when differences of opinion arise common in business circles could be transferred to public ones. This is not because the facts are not available, for most of them are such as are of public record. The condition exists in spite of these existing records, and often without consulting them. On a recent occasion it was my duty to point out that in a paragraph from an address by a well-known man of affairs on certain public subjects not a single correct statement was made; yet the facts concerning which the statements were made were all of them available on request and without expense.

It must not be understood, however, that I am now making either a sweeping or a specific charge of untruthfulness or of desire to misrepresent. I am dealing with a condition and not with persons and a condition in which persons of unquestioned probity and honor constantly act and speak concerning public affairs without the precise information on which they commonly act in private matters. This is not because they have ceased to be upright and truthful men, but because the standards respecting facts do not seem to be quite the same

nor is the same care always taken to ascertain the facts. There is no question in my mind that the gentleman whose remarks I had occasion to correct would in the management of a factory be scrupulously careful to learn the facts before he spoke concerning them to his board of directors. So far, however, as my knowledge goes, though the records concerning the facts of which he inaccurately spoke are in the Department of Commerce, no effort was made to ascertain them.

Neither must it be understood that I single any one person out or any party or locality. It has been my experience that the same separation from the normal accuracies of life has occurred with men of many varying views and of different localities when they came to speak of public matters. It seems to be a general and not a particular condition.

I once noticed when having charge of a portion of the highways of an important city that many citizens spoke as if they were intimately informed respecting the somewhat technical subject of street pavements. Possibly it is because we assume that our public affairs are easily grasped by all men without special inquiry concerning them that this habitual inaccuracy appears in conversation and criticism. So far from its being easy to know and understand our multiplex public matters I think it is true that many if not most of our citizens have but vague conceptions of what the actual detailed operations of the government are. One is constantly requested in all goodwill and sincerity to do that which is impossible or even unlawful. I received but a few days since a numerous signed petition urging that the department enter upon a line of business not only unknown to the law but which would require an amendment to the constitution of the United States to make a law concerning it

possible. Possibly the fact that we have all been taught that power lies in a democracy with the people leads some to think that anything which some individuals desire is therefore both lawful and possible.

Accompanying the comments based upon absentee facts are others which deal with assumed motives having no sounder basis. It is but a few days since the unconscious act of one in no way connected with the government was made the basis of a charge that an important service had sold itself, and was described in adjectives as lurid and abusive as they were wanting in basis.

This is, however, neither a complaint of conditions nor a plea for relief, but a suggestion for helpfulness. No administrator worthy the name but welcomes candid and constructive criticism, and from many sides I have received comments and suggestions through many years that have altered methods and improved results. It is the fact of course that criticism and attack, having no basis in truth, pass by one as the idle wind which one respects not and has no result save to injure the influence of the critic who descends to such means, if it is consciously done. The problem that needs solution, however, is how to guide men who wish to speak clearly and accurately out of the all too pervading habit of doing neither when public business is concerned. It is, I believe, assumed that through the daily press we have a means of throwing light on all these things and one would be foolish to deny that much light is continually thus thrown. We must not, however, in justice to that press, forget that the nature of its service requires that what they print shall be of the day, daily, or almost of the hour, hourly; that a thing to have news value must in some degree be new or, to have what is technically called "punch," must have some element more or less of the dramatic, or must have such a

character as will arrest attention. Unfortunately for the public mind, much that needs to be known has neither character. The larger part of the useful and productive work of a government department is not only nonpolitical but is continuous, developing steadily from day to day, similar in its character to the operation of a factory or a business, turning out a regular product which does not have in it always the appeal of the moment which gives it either "punch" or news value.

These things, therefore, are not and in a sense can not be grist for the mill of the daily press even though they may be more important in the way of information than that which falls more truly within the class of the said grist.

There is, therefore, something yet to be done in the way of bringing before the people who own the government the facts respecting that government in its daily evolution. It has been a pleasure to me in more than one city (among them this one) to speak of the work of the Department of Commerce to busy men of affairs. It has interested and enlightened me to see how keen an interest has been taken and how much surprise has at times been shown on learning the facts. There is every reason to believe that other departments than that of commerce contain as much if not more of interest to the average man.

I should myself be guilty of inaccuracy if there is left in your minds any impression to the effect that the press in any of its forms is deemed negligent of its duty to inform the owners of the government respecting their own affairs. This does not seem to be the case. It is rather that all the conditions are such that in a matter of grave importance to every one of us the necessary means of publicity for full knowledge by us all of our affairs is not available. We do not ignore the fact that maga-

zines of many kinds, and frequent articles in numerous other publications, throw much light upon some of the operations of various public services, but there does not seem to be available any regular and systematic source of adequate knowledge as to what is regularly going on. Books, indeed, several of them, exist having this for their purpose, and they are good to have and read. Yet it is doubtful if any of them really fulfils its mission. Such an organization as the Chamber of Commerce of the United States continuously and with effect strives to perform for the business world the function of giving knowledge concerning the government. It maintains committees which are in more or less frequent touch with different departments; it publishes a paper of much value; yet I doubt if its able and effective officers would feel that their function lay in the way of informing the whole public on all our governmental affairs or even if they would say that they had as yet reached that state of perfection of information for their own share of our public that they themselves desire.

The truth seems to be that in a republic where a knowledge of public affairs is more or less charged upon us all by the very nature of our institutions these same institutions have grown so vast and far-reaching, so intricate in their operations, that it is, to say the least, extremely difficult for any one to follow them. Indeed, one might talk to you for two hours on the work of a single bureau of the Department of Commerce without exhausting that subject, yet neither that bureau nor that department is among the largest there are. If to the burden thus imposed, happily without consciousness, upon the average man, there is added that of understanding his own state and municipal affairs, plus the duties of his own vocation, the responsibilities of the citizen of a republic would seem onerous indeed.

It would undoubtedly, however, be pushing our thought much too far to urge any such comprehensive view as the duty of any single man. For one such to follow the daily changes arising from the evolution of our national government would be itself a serious task. The important thing, and the thing which unfortunately exists far too little, is to know accurately the things which we do know. How is this to be done? Each department is a great storehouse of facts which in many ways it strives to make known and to utilize. In dealing, as we in our department do, with the promotion of our foreign trade in one of our services, the problem is ever before us how to let the business world know what we are actually doing for it. Through branch offices, by use of press and platform, by the publication of a daily paper, by official reports, monographs, and such other use of the press as brings our annual total of expenditures for printing up into the hundreds of thousands of dollars per annum, we strive to inform the people. Yet we are conscious that much more needs to be done than is in fact accomplished. It is a common thing to have men say when this or that or the other thing is shown them, "I had no idea of this." Speaking not long since to a prominent manufacturer of the work in behalf of manufactures of one of our great bureaus he said he had not even heard of the bureau. I do not mean that he was to blame. The fact is the means of informing our people on their own affairs, even in this land of printing presses and publications, either are not adequate, or if they are sufficient they do not for some reason perform the function.

Possibly some may say that official reports are not so juicy a type of literature as to afford pleasant food for the mind, and no one who has had to write such a report would argue to the contrary. Nevertheless

the facts of the government's daily work are many of them of surprising interest. The discovery of a great unknown bed of edible scallops extending hundreds of miles along the Atlantic coast, the utilization of sea mussels for food, a use common in Europe, hitherto neglected here but now springing into activity; the finding of great fishing banks close by the Oregon shore not hitherto known to exist, the maintaining of the pearl button industry by inoculating fish through a biological laboratory near the Mississippi River with a parasite which in time becomes the fresh water clam, the finding of decorative millinery in the bottom of Long Island Sound in the shape of a primitive sea animal, which becomes beautiful when both dead and dyed—these are simply part of the ordinary routine work of the Bureau of Fisheries. It would be easy to go on in this same service and tell how a certain river perch lays a mass of eggs much larger than itself and how fish exist which are good for food yet are thrown away at a time when men complain of the high cost of living. One could go on for long telling of matters of this kind. They are facts which affect daily life sometimes to the extent of altering its conditions. Here a slight change in a government specification opens a great market to American cements that were theretofore excluded; there a hint that a certain duty has been modified leads to the large exportation of coal. A few lines in print open the way to the shipment of hundreds of cases of glass abroad. The study of a ceramic chemist in the quiet of his laboratory produces a leadless glaze and destroys the evils of lead poisoning. Some work of the same man develops value out of hitherto useless clays and makes possible the production of porcelain of a kind not made here before.

It would be easy to run on. These are

only faint indications of living matters of interest conducted by the public and for the public but of which the public does not get that close and intimate knowledge which it is desirable they should have.

I have not touched upon the extent to which partisanship or passion may come in to modify facts or to obscure them. I regret that it should be true that half-truths should be as common among us as they are. Let us, however, deal to-day not with matters known and controverted even though known but in part and that which is known used but partially. We have spoken rather of things of general interest that are not controversial but which in their aggregate mean the service that the people through their organized government are doing for themselves.

You will doubtless observe I have presented no remedy for the weaknesses that have been suggested. This is because I do not know of any panacea that will work any immediate or even extended cure. We are so busy in the actual work striving to make the doing useful to those for whom it is done, so actively facing the difficulties of being as helpful as we desire, that we are perhaps more conscious of the struggle than prophetic of success in it. This is not a confession of defeat, for on the contrary much accomplishment is real. It is only when we measure what all of us who own our affairs would like to know and ought to know about those same affairs beside the ability to inform them of those affairs that the task seems hard.

A mental danger besets us all. It is that of parochial thinking. It is all very well for a man when he is dead to rest his bones within the quiet shades and encircling wall of some churchyard, but he needs a larger sphere while he is alive. Up to the time when a man leaves school to begin a man's job in the world I suppose it may be said,

generally speaking, to be true that his mind has worked chiefly intensively. From that time on I suppose it to be true that the mind should work chiefly extensively. The point at which one method of thinking passes over into the other would be hard to trace. One can do extensive thinking in school and must do intensive work after assuming the work of life. None the less, generally speaking, I believe that the training of young manhood looks to the extension of thought in maturer life. You are not primarily going on to get facts out of books and out of the laboratory and out of the experience of others into your mind. You are to begin to take the facts which that mind has digested and to work them out into useful forms and into productive service. You have been perhaps the beneficiaries hitherto of the things which have been created and of the thoughts which others have worked out in the crucible of their own mental processes. You are now to become in a sense creators and to think both for yourselves and others. You have been one may say absorbers; you are to become producers. Your value as men depends on what the product shall be.

The country is not so greatly concerned, I venture to believe, with the amount that a man knows as it is with the use he makes of what he knows. It does not want the man who, while his body may live, still keeps his mind in a mental churchyard. One of the great phrases of the Old Testament says: "Thou hast taken me and Thou hast set me in a large place;" and what the world needs is men who can think in great areas. It is necessary but it is not sufficient to get the facts. One who would do a man's job in the world must through those facts serve his fellows.

Think, if you please, what the symmetry of life should be. It should not be narrow; it should not be crooked. It should be

straight and square. It should be high, to keep out of the dust and mire. It should be broad that it may rest securely. It should be deep based on the eternal verities. It must not be low, for living things grow upward into the light. I would have you question all your life long whether this or that or the other form of alleged truth which is presented to you be so or not. If it is found not to be the truth I would have you reject it without regret and without fear of inconsistency, for there is some force in the statement that consistency is the virtue of weak minds. Truth is progressively revealed and one must readjust himself in thought and action to the greater knowledge of truth that we ought continually to gain. The man who at fifty thinks as he thought at thirty has mentally ceased to grow. If one's mind is open to the light whencesoe'er it may fall, if one's steps are guided by that light whithersoe'er it may lead, there is little to fear either as to treading the path safely or as to the place in the world to which it shall conduct one.

WILLIAM C. REDFIELD

MINERAL PRODUCTION IN 1915

"THE mid-year finds the mineral industries of the United States generally prosperous and enjoying a revival of active development." With this statement the director of the United States Geological Survey opens an official review of mining conditions as reported to him by the government geologists and statisticians working on this subject. "This revival is particularly true of some of the metals for which increased demands have been noted during the past six months. This country has been first thrown upon its own resources for mineral products required and, next, given the opportunity to supply the needs of foreign countries who have offered us their trade. Comparative freedom from foreign competition and, in some important cases, increase of foreign markets